



Climate, Earth system project draws on science powerhouses

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Los Alamos teams with climate and high-performance computing groups for advanced climate change understanding

LOS ALAMOS, N.M., Sept. 25, 2014—With President Obama announcing climate-support initiatives this week at the 2014 United Nations Climate Summit, the US Department of Energy national laboratories are teaming with academia and the private sector to develop the most advanced climate and Earth system computer model yet created. For Los Alamos National Laboratory researchers, it is a welcome advance for an already vibrant high-performance computing community.

Accelerated Climate Modeling for Energy, or ACME, is designed to accelerate the development and application of fully coupled, state-of-the-science Earth system models for scientific and energy applications.

"The ACME partnership will provide new capabilities that improve our ability to project future impacts of energy choices on the Earth's climate," said Alan Bishop, principal associate director of Los Alamos National Laboratory's Science, Technology and Engineering directorate.

"The national laboratories' high-performance computing capabilities will enable better regional detail, and the addition of ice sheet processes and improved ocean and sea ice components will help to better quantify future sea-level rise."

The project — which includes seven other national laboratories, four academic institutions, and one private-sector company — will focus initially on three climate-change science drivers and corresponding questions to be answered during the project's initial phase: water cycle, biogeochemistry, and cryosphere systems.

Over a planned 10-year span, the project aim is to conduct simulations and modeling on the most sophisticated high-performance computing systems machines as they become available — 100+ petaflop machines and eventually exascale supercomputers.

To address the water cycle, the project plan hypothesized that: 1) changes in river flow over the last 40 years have been dominated primarily by land management, water management and climate change associated with aerosol forcing; 2) during the next 40 years, greenhouse gas (GHG) emissions in a business as usual scenario may drive changes to river flow.

“A goal of ACME is to simulate the changes in the hydrological cycle, with a specific focus on precipitation and surface water in orographically complex regions such as the western United States and the headwaters of the Amazon,” the report states.

To address biogeochemistry, ACME researchers will examine how more complete treatments of nutrient cycles affect carbon–climate system feedbacks, with a focus on tropical systems; and investigate the influence of alternative model structures for below-ground reaction networks on global-scale biogeochemistry–climate feedbacks.

For the cryosphere component of the effort, the team will examine the near-term risks of initiating the dynamic instability and onset of the collapse of the Antarctic Ice Sheet due to rapid melting by warming waters adjacent to the ice sheet grounding lines.

The experiment would be the first fully coupled global simulation to include dynamic ice shelf–ocean interactions for addressing the potential instability associated with grounding line dynamics in marine ice sheets around Antarctica.

Los Alamos scientists will play a vital role in the project, developing the ocean, sea-ice, and land-ice (3 of the 5) component models within the ACME system. They will also be leading the cryosphere and sea-level rise science directions where the ocean and cryosphere are most important. Ocean circulation, polar warming and ocean and ice ecosystems also contribute strongly to the water cycle and biogeochemistry science directions. Los Alamos researcher Phil Jones is an ACME council member and will be leading a team of 20 Los Alamos scientists in these efforts.

Fourteen institutions will work together to develop the most accurate climate change predictions yet, and investigate key fundamental science questions, such as the interaction of clouds and climate and the role of secondary organic aerosols. The partners include eight national laboratories — Los Alamos, Sandia, Argonne, Brookhaven, Lawrence Berkeley, Lawrence Livermore, Oak Ridge, Pacific Northwest — along with the National Center for Atmospheric Research, four academic institutions and one private-sector company.

Initial funding is provided by DOE’s Office of Science. More information can be found in the [Accelerated Climate Modeling For Energy: Project Strategy and Initial Implementation Plan](#).

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